

increase life, magic to sustain life, and magic to win love. There are myths and folklore, worldviews, poetry, and even attempts to control the weather. We are universal people!

Brown, D. (1991). *Human universals*. New York: McGraw-Hill.

II. Behavior Genetics: Predicting Individual Differences (pp. 95–103)

A. Genes: Our Codes for Life (pp. 95–96)

Classroom Exercise: Genetic Factors

The text discussion of the role of genetic factors in shaping our traits and behaviors can be readily expanded in class. Explain how we inherit one set of 23 chromosomes from each parent. The two sets form pairs that contain alternate genes for the same traits. Sometimes, one gene is *dominant* and “overrides” the *recessive* gene. For example, in the determination of eye color, the brown-eye gene is dominant. If either parent contributes this gene when conceiving a baby, the child will have brown eyes. Only if both genes are recessive will the child have blue eyes.

		Father's two genes	
		F ₁	F ₂
Mother's two genes	M ₁	F ₁ M ₁	F ₂ M ₁
	M ₂	F ₁ M ₂	F ₂ M ₂

A few other traits and behaviors are inherited in the same straightforward manner. For example, the relative lengths of the forefinger and ring finger seem to be controlled by a simple genetic mechanism. Have students draw a straight horizontal line on a sheet of paper. When the tip of their ring finger is placed on the line, does the tip of the forefinger also reach the line? Research indicates that short forefingers is a recessive trait in females, whereas in males it is dominant. Thus, in a large class you should find more short forefingers among males than females. Also ask students if they can bend their thumb back from the second joint at a 45° angle. When interlocking their fingers, do they place the left or right thumb on top? The point of these examples is that the particular characteristics are genetically controlled. Practice or experience has no effect.

Sandra Singer suggests still another example of a genetically determined difference for class demonstration: taste sensitivity to phenylthiocarbamide (PTC). To about 70 percent of the adults in the United States, a

diluted dose of this chemical compound has an extremely bitter, unpleasant taste. For the other 30 percent, the same concentration of PTC is tasteless. Because of the proportion of “tasters” to “nontasters,” and because no environmental factors seem to influence this difference in taste sensitivity, PTC taste blindness is most likely the product of a single recessive gene pair. PTC-impregnated strips are very inexpensive and can be obtained from most biology supply houses. Distribute the strips and calculate the number of tasters and nontasters. Singer reports invariably finding both in every group. Both groups will be amazed at the difference in each other's experience.

Rick Straub suggests a number of examples to help students understand dominant-recessive inheritance patterns. Begin by drawing the Punnett square on the board, giving a brief explanation of how it is used. Use eye color to illustrate.

Then have the class answer these questions.

1. A man with red hair (recessive) marries a woman with black hair (dominant) whose mother had red hair. What are the chances that their first child will have red hair? (Two chances in four.) Black hair? (Two chances in four.)
2. A man and a woman both have brown eyes, but their first child has blue eyes. What are the chances that their second child will have blue eyes? (One chance in four—the odds of blue eyes is the same regardless of how many previous children already have blue eyes.)

You may want to construct additional examples: Curly hair, dimples in the cheeks, unattached earlobes, and farsightedness are dominant traits. Their counterparts—straight hair, no dimples, attached ear lobes, and normal vision—are recessive characteristics. You might note that while more complex traits may also be simply determined (as is one's sex, though not by a dominant-recessive pattern), genetic influence is typically more complicated. That is, many genes interact to help create the trait.

Singer, S. (1984). *Classroom demonstrations: Individual differences*. Paper presented at the 92nd Annual Convention of the American Psychological Association, Toronto.

Straub, R. O. (2009). *Instructor's resources to accompany The Developing Person Through Childhood and Adolescence* (8th ed.). New York: Worth.

Lecture/Discussion Topic: The Origin of Blue Eyes

The text notes that both geneticists and psychologists study the occasional variations found at particular gene sites, which contribute to each person's uniqueness. Geneticist Hans Eiberg and his research team at the University of Copenhagen have identified a genetic

mutation that occurred 6000 to 10,000 years ago and is the cause of blue eyes. Remarkably, their careful analysis suggests that all blue-eyed humans have a single, common ancestor and thus are related.

Originally, notes Eiberg, all humans had brown eyes. However, a genetic mutation affecting the OCA2 gene resulted in the emergence of a “switch,” which literally turned off the ability to produce brown eyes. The OCA2 gene codes for the P protein that is involved in the production of melanin, a class of compounds that color our hair, eyes, and skin. The switch that is found in the gene adjacent to OCA2 does not turn off the gene entirely but rather limits the production of melanin in the iris and thus “dilutes” brown eyes to blue. If, in fact, the OCA2 gene had been completely turned off, humans would be without any color in their hair, eyes, or skin, a condition known as *albinism*.

Varying amounts of melanin in the iris are associated with brown or even green eye color. In contrast, blue-eyed individuals show only a very small amount of variation in the amount of melanin in their eyes. Eiberg’s team examined 155 people from Scandinavia, Turkey, Jordan, and India looking to see whether they all had similar DNA sequences on the critical gene. To their surprise, they found that they indeed had identical DNA sequences in that region of the gene, an indication that the mutation happened so recently that it has not had time to change.

Elberg claims that “From this we can conclude that all blue-eyed individuals are linked to the same ancestor. They have all inherited the same switch at exactly the same spot in their DNA.” In contrast, those with brown eyes show considerable individual variation in the area of their DNA that controls the production of melanin.

Blue eyes are relatively rare in the United States as compared to countries where the mutation first occurred, which was likely somewhere in the Balkans or near the Black Sea. In Estonia, 99 percent of people have blue eyes; in Germany, 75 percent have blue eyes. Thirty years ago, only 8 percent of the Danish population had brown eyes; however, as a result of immigration that number today is about 11 percent. Everyone has two genes for eye color, one from each parent. Brown eyes are dominant and thus blue eyes can occur only when both parents carry at least one blue-eyed gene. Potentially, the recessive gene for blue eyes can remain invisible for generations.

The gene mutation for blue eyes represents neither a positive nor a negative mutation. It is one of several mutations such as baldness, freckles, and beauty spots which neither increase nor decrease a human’s chance of survival. Eiberg concludes, “It simply shows that nature is constantly shuffling the human genome, creat-

ing a genetic cocktail of human chromosomes and trying out different changes as it does so.”

University of Copenhagen (2008, January 31). Blue-eyed humans have a single, common ancestor. *ScienceDaily*. Retrieved March 9, 2008, from www.sciencedaily.com/releases/2008/01/080130170343.htm.

Classroom Exercise/Student Project: Genetic Influences

To demonstrate genetic influences on behavior, you may want to use the simple classroom exercise described in Unit 4, Sensation and Perception. “Genetic Effects on Taste” demonstrates how people’s ability to taste the bitter substance PROP is genetically determined. About 75 percent of Americans are tasters; of those, 25 percent are supertasters. As Unit 4 of this resource book notes, you can use tongue painting and a reinforcement ring to assess supertasting.

Lecture/Discussion Topic: The Genetic Revolution

In introducing the latest research in genetics, you might pose the following questions to your students:

1. If it were possible, would you want to take a genetic test telling you which diseases you are likely to suffer from later in life?
2. Suppose you or your partner are pregnant. Would you want the unborn child tested for genetic defects?
3. Do you think it should be legal for employers to use genetic tests in deciding whom to hire?

The C. S. Mott Children’s Hospital Poll on Children’s Health, conducted in March 2007, asked respondents their opinions about genetic testing of children and adults for disorders where effective treatments do or do not exist. A total of 54 percent reported wanting genetic testing even if no effective treatment is possible. A smaller 39 percent wanted genetic testing only if effective treatment is available. A slim 7 percent indicated that genetic testing should never be conducted. Except for non-Whites, who were more likely to want genetic testing even if no effective treatment is available, there were no differences in attitudes about genetic testing by age, gender, education, income, or health insurance status.

Advances in genetic testing have led to proposals for DNA biobanks, essentially collections of DNA from groups of individuals in the population and linked to other health information, including medical records. Such biobanks would allow the government to track health data and to contact individuals when new treatment and prevention strategies become available. The Mott poll asked parents if they were willing to have their children’s DNA stored in a government DNA biobank. In addition, all the respondents (whether par-

ents or not) were asked whether they were willing to store their own DNA in a biobank. Overall, the same 38 percent indicated a willingness to have their children and their own DNA stored. A total of 33 percent were unwilling, and 29 percent were unsure.

Thanks to the mapping of the human genome, scientists are rapidly identifying the genetic codes for various diseases. Genetic tests are presently available for many illnesses, including Huntington's disease, cystic fibrosis, and Tay-Sachs disease. In some cases, ability to predict is accompanied by an ability to cure. For example, the genetic predisposition to hereditary hemochromatosis, a potentially fatal disease that causes iron to build up in the blood, is easily treated. On the other hand, Huntington's disease is incurable. Knowing your vulnerability is a mixed blessing at best.

For some, the most worrisome development of the genetic age is the likelihood that knowledge of a person's genes will be used against them. A drop of blood or a lock of hair could tell a potential insurer or employer whether someone is at risk of contracting any of a long list of debilitating diseases. In 1993, James Tatum, a 43-year-old postal supervisor from Turlock, California, suddenly lost his sight. Although the U.S. Postal Service approved his request for a disability retirement, the Department of Labor subsequently denied it, arguing that Tatum's blindness was caused by a genetic disorder. Thus, his condition predated his employment and was not covered by employment benefits. A more recent American Management Association survey of 2133 companies found at least seven using genetic testing on workers. In February 2001, the Equal Employment Opportunity Commission filed its first genetic-testing lawsuit in which it accused Burlington Northern Santa Fe Railroad of collecting genetic samples from employees without their consent. Apparently, the tests were used to evaluate compensation claims filed by workers suffering from carpal tunnel syndrome, a repetitive motion injury that may be linked to a genetic mutation. The workers claimed that the company was seeking to blame any future health problems on their genetic makeup rather than attribute them to physical stress on the job. In May 2002, 36 railroad workers won a \$2.2 million out-of-court settlement from Burlington.

The Cambridge-based Council for Responsible Genetics has documented hundreds of cases of genetic discrimination in the health industry. For example, a healthy child was denied insurance because of a genetic predisposition to a heart disorder. On May 21, 2008, former President George Bush signed the Genetic Information Nondiscrimination Act (GINA) into law. It prohibits health insurers from denying coverage to a healthy individual and from charging that person higher premiums based solely on a genetic predisposition to an illness. GINA also prohibits employers from using genetic information in hiring, firing, job placement, or

promotion decisions. The bill, debated in Congress for 13 years, had passed the Senate unanimously and the House by a vote of 414 to 1.

Genetic tests outpace efforts to safeguard people's data. (2002, August 20). *USA Today*, p. 10A.

Hawkins, D. (2001, March 5). Guard your genetic data from those prying eyes. *U.S. News and World Report*, 59–60.

National Human Genome Research Institute (2008, May 21). Genetic Information Nondiscrimination Act: 2007–2008: President Bush signs Genetic Information Nondiscrimination Act of 2008. Retrieved July 15, 2008, from www.genome.gov/24519851.

The telltale gene. (1990, July). *Consumer Reports*, 483–488.

Thompson, D. (2000, January 24). The gene machine. *Newsweek*, 58.

University of Michigan Health System (2007, June 20). C. S. Mott Children's Hospital National Poll on Children's Health: Genetic Testing and DNA Biobanks—For Whom, and When? Retrieved July 15, 2008, from www.med.umich.edu/mott/research/CBH%20Poll/NPCH%20vol1%201%20issue%204%20June%2020%20FINAL.pdf.

B. Twin and Adoption Studies (pp. 96–100)

Classroom Exercise: Striking Similarities

As the text reports, striking similarities have sometimes been found between twins who are reunited after years of separation. Does this suggest the importance of the genetic factor in personality and behavior? Or will any two people find some remarkable similarities just by chance? To demonstrate the latter possibility, David Myers has created an activity from materials provided by Joseph Wyatt. Distribute a copy of Handout 3C–2 to each student, pair students off (preferably with someone they don't know), and give them 5 or 10 minutes to see how many similarities they can discover. Tell them, "you'll differ in lots of ways—don't worry about these, we're just interested in whether you can find some similarities."

If you have an odd number of students, pair off with someone yourself. The first time Myers did this with a student, he found within 5 minutes that they "both like basketball, had watched Syracuse defeat Georgetown the previous evening, hate Brussels sprouts, sleep seven hours, chew Wrigley's spearmint, use Crest, read *Time*, prefer nonfiction books, view the nightly news and not much else, are right-handed, outgoing persons."

Lecture/Discussion Topic: The Minnesota Twin Study

The Minnesota Study of Twins Reared Apart, introduced in the text, can be readily extended in class. The study, directed by Thomas J. Bouchard, began in 1979

and involved a week-long medical and psychological assessment of identical and fraternal twins separated in early life and reared apart. The psychological assessment included multiple measures of personality, mental abilities, values, interests, psychomotor skills, reading, spelling, and writing. The medical assessment involved a psychiatric interview, a medical life history, a standard blood battery, and even detailed dental and periodontal exams. This massive study provides many examples of separated identical twins showing remarkable similarities. Psychologist Nancy Segal's *Entwined Lives* describes how the Minnesota study even included a set of triplets. Although raised separately, Bobby Shafran, David Kellman and Eddy Galland shared similar personalities described as "intelligent, extraverted and slightly rambunctious." Bobby and Eddy were reunited by one of Eddy's college friends. When David saw a newspaper photo of his brothers, he immediately contacted his siblings and the triplets were fully reunited.

Separated as infants, twins Gerald (Jerry) Levey and Mark Newman grew up to share characteristics ranging from their firefighting avocation to taste in beer. Neither knew of the other's existence until a shared acquaintance brought them together. Upon meeting for the first time each saw his own reflection. They had grown the same mustache and sideburns, and each wore the same glasses. As the brothers talked, they discovered they had more than looks in common. Levey went to college and graduated with a degree in forestry. Newman planned to go to college to study the same subject but opted to work for the city trimming trees. Both worked for a time in supermarkets. Levey had a job installing sprinkler systems. Until relatively recently, Newman had a job installing fire alarms. Both men are bachelors attracted to similar women—"tall, slender, long hair." In addition to being volunteer firefighters, they both share favorite pastimes of hunting, fishing, going to the beach, watching old John Wayne movies and pro wrestling, and eating Chinese food in the wee hours after a night on the town. Both were raised in the Jewish faith but neither is particularly religious. Both men drink only Budweiser beer, holding the can with one pinkie curled underneath and crushing the can when it's empty. In becoming acquainted, observes Jerry, "we kept making the same remarks at the same time and using the same gestures. It was spooky. . . . He is he and I am I, and we are one."

The twins in the Minnesota study completed a number of interviews and tests. Thomas Bouchard and his colleagues reported that heredity accounted for 64 to 74 percent of the differences seen in IQ between the identical twins. Previous studies found that heredity explained 47 to 58 percent of the variance. The Multidimensional Personality Questionnaire (MPQ)

evaluated the twins for impulsiveness, aggressiveness, need for achievement, traditionalism, stress reaction, sense of well-being, social potency (including traits such as leadership), social closeness, alienation, harm avoidance, and absorption, or "proneness to imaginative activities." In each of these areas researchers found heritability of about one-half. The figures ranged from 39 percent for achievement to 55 percent for harm avoidance. The researchers emphasize that the significance of the findings is that heritabilities were found at all. More surprising is that they all hovered at about 50 percent. (It is wise to remind students what these percentages mean. For example, 90 percent of the variation in people's height is genetic and 10 percent is environmental. These figures apply to the population as a whole, not to individuals. "We don't say that 90 percent of *your* height is influenced by genetic factors and the other 10 percent by environmental factors," says Minnesota psychologist Nancy Segal. "Rather, that ratio represents the proportion of differences among people that can be explained by genes or by environmental influences.")

More interesting findings from the Minnesota study are found in the research team's report titled "What's Special About Twins to Science?" (see www.psych.umn.edu/psylabs/mtfs/special.htm). For example, the team has attempted to answer the question, "Could divorce be inherited?" The divorce rate for Minnesota couples is about 19 percent. However, the investigators report that if you are an identical twin and your co-twin is divorced, your risk of divorce is 45 percent; if you are a fraternal twin and your co-twin is divorced, your risk of divorce is 25 percent. Conclusion? There is not a "divorce gene" but similar divorce rates of identical twins are due to their having genetically influenced personality characteristics that contribute to marital adjustment.

Clearly, the Minnesota study does not provide a perfect assessment of heredity's contribution to our traits (including intelligence) and has led to some questions about the reliability of twin studies. For example, separated identical twins shared the same prenatal environment. If those nine months are crucial in determining how the brain is wired, environment is already having a significant impact before birth. This would also help explain why fraternal twins (who are no more alike genetically than any brother and sister) have IQs more alike than ordinary siblings. Moreover, separated identical twins are rarely separated at the moment of birth. The twins in the Minnesota study had on average 5 months together before they were separated. If the first 6 months of life are indeed important, environment could still be contributing to their similar personality traits. Finally, after their reunion, the twins averaged nearly two years together before they participated in the study. Naturally, the researchers paid special attention to their similarities and may, as some critics have argued, have come to "mythologize" the twins relationship.